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(54) Crushing machine with jaws, particularly adapted to the recycling of materials.

(57) Crushing machine with jaws (4,5) regulating the size of the material in exit by means of a controlled distance, between the fixed (5) and mobile jaw (4) and with a safety device against uncrushable material blocks, composed of interposed oleo-hydraulic cylinders (7) between one of the jaws and the body (1), the said cylinders (7) being connected to an oleo-hydraulic circuit with valves of maximum pressure.

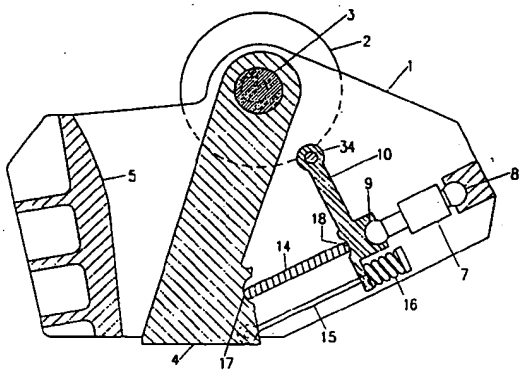

FIG. 2

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The present innovation is an evolution of the patent entitled "Frantumatore alternativo", (Alternative crusher) whose application form was filed on 19th December 1990 at the Provincial Office of Industry, Commerce and Artisanship of Venice with number 61977 B/90 and concerns a new crushing machine with correction jaws of the size of the material in exit, by means of the control of the distance between the fixed and mobile jaws, and with a safety device against uncrushable material blocks that may accidentally enter into the crushing chamber.

The crushing machines with traditional jaws exploit the principle of the breaking of the material that is being compressed between two jaws, of which one is fixed and the other mobile, the mobile jaw being operated by an eccentric power-operated shaft that acts on the upper side and by an articulation of a connecting rod that acts on the lower side, in the crusher called "a simple toggle", or the hinged mobile jaw being linked to the frame in the upper part and operated by an eccentric power-operated shaft through a double articulation connecting rod, in the crusher called a "double toggle". As is known, the traditional crushing machines have a correction system for the size of the material in exit which is awkward to use, being composed of a series of thicknesses inserted or removed between the connecting rod and the casing when the machine is standstill, with consequent laboriousness and production loss due to the inactivity of the machine. It is also known that in such machines the use of the safety device against blocks of uncrushable material is remarkably unsuitable and wasteful, this device being composed of the well known connecting rod or other breakable component that permits the mobile jaw to space itself from the fixed one beyond the correction value, in order to eliminate the uncrushable material without giving rise to further and more serious damages to the machine. Since the security system is based on the breaking of a component, the relative reset involves an non-functional machine for many hours, for the replacement of the component and a notable cost for the material and labour.

Considering the data above, the drawbacks of the traditional crushing machines are evident, especially if utilized in crushing with the aim of recycling materials arising from demolitions, inasmuch as it is not possible to alter, with ease and continuity, the size of the material in exit during the functioning of said equipment and it is not possible to rapidly reset the machine once the security system. has intervened

The aim of the present invention is precisely that of highlighting the aforementioned drawbacks and to define a crushing machine characterized by the possibility of varying with continuity, the size of the material in exit, during the normal functioning of the apparatus, and characterized by the fact that the security system against uncrushable material blocks is immediately able to be reset after the intervention.

More specifically, the device that allows the adjustment of the distance between the fixed and mobile jaws can assume different relative configurations, all characterized by the use of oleo-dynamic cylinders that act, depending on the solutions illustrated below, on the fixed jaw, on the mobile jaw, on the well known connecting rod or on one of the connecting rods in case of mills with double toggle.

In all the realizable solutions that will be illustrated, the security function against uncrushable material blocks is entrusted to the oleo-hydraulic cylinders, connected to a circuit with one or more valves of maximum pressure that allows the discharge of the oil contained in the cylinders in case the pressure corresponding to the established maximum is exceeded, allowing the opening of one of the jaws and the consequent exit of the uncrushable block.

In what follows five preferential realizations of the inventions are described that take as reference, the typological constructive scheme of a simple connecting rod crusher, for reasons of simplicity in the description. The same preferential realizations can make reference to the typological constructive scheme of the double toggle crusher, without changing the functional mode of the innovation.

According to a preferential realization of the present invention, the cylinders that carry out the double function of regulation of the distance between the jaws, determining the size of the material in exit and of the safety against uncrushable material blocks, are connected by means of rotary bilateral couplings, that may be spherical articulations or cylindrical hinges, respectively to the mobile jaw and to the body of the machine. In this way, said cylinders, besides performing the two functions of correction and safety mentioned above, also replace the well known connecting rod, (traditionally, in the conventional crusher, to perform the safety function against uncrushable material blocks), whose breakage is pre-established. A normal oleo-hydraulic distributor allows the regulation of the opening of the jaws, while one or more valves of maximum pressure, duly calibrated, and of appropriate size, allow the rapid opening of the jaws to eliminate the block of uncrushable material, once the effort that is being used to generate itself for the presence of said block between the jaws, allows the calibration pressure of the valves in the cylinders, to be overcome. The rotary couplings between oleo-hydraulic cylinders and mobile jaw

and between the said cylinders and body may be of a unilateral type, as in the case of two cylindrical surfaces, one concave, and the other convex, with more or less the same radius, or two spherical surface segments, being in this case necessary to prearrange a known tensioning system of the movable jaw towards the body, of the pulling and spring type or oleo-hydraulic cylinder connected to an oleo-pneumatic accumulator. In case the rotary couplings are of the bilateral type, the function of the tensioning may be carried out from the said oleo-hydraulic cylinders connected from the side of the stem with an oleo-pneumatic accumulator.

According to a variation of the invention, the oleo-hydraulic correction and safety cylinders do not act directly on the mobile jaw, as in the solution described above, but on the well known connecting rod linked to the mobile jaw through an intermediate guide that may be of linear or flag type, the latter being hinged to the upper part of the isolated dihedral from the passing surfaces of the said cylinders and the well known connecting rod, or on the underside depending on the movements that one wishes to allow at the extremity of the flag, where the rotary couplings of the well known connecting rod and the cylinders converge. The evident advantage of this solution, (mechanically more complex with respect to the preceding), consists in being able to utilize a conventional type connecting rod with their own rotary couplings known and experimented in the technique, and to entrust to the cylinders only the correction and safety functions, without soliciting the rotary couplings of the same cylinders with continuos movements, these couplings having a very modest relative motion only in the correction case of the distance between the jaws or of the entering into function of the safety device against uncrushable material blocks, but not during the normal functioning, at numerous cycles per second, with less consequent wear and functioning reliability. Another advantage of this solution is in the sizing of the oleo-hydraulic cylinders that, if they lie on the surface not coinciding with the surface of the well known connecting rod, forming the two planes into a dihedral angle, may be expedited with less effort than if the case were coplanar to the well known connecting rod, depending on the amplitude of the above mentioned dihedral angle. In this case the effort coming from the well known connecting rod would discharge itself in part directly on the frame by means of the intermediate flag guide, or the intermediate linear guide, being-able to utilize cylinders of smaller bore or make them work at a lower pressure, with repercussions on the cost or on the reliability of oleo-hydraulic components. Finally with this solution, when the surface of the well known connecting rod and that of the cylinders almost coincide, it is possible to maintain, for the end part of the movable jaw, the same optimal trajectory that has been defined in the kinematics project site of the machine, also varying the opening of the jaws a great deal and therefore the size of the shattered material in exit.

According to a third realization of the invention, the correction of the opening of the jaws and the safety against uncrushable material blocks is carried out, by acting on the fixed jaw that must be such during the normal working of the machine, but may move when it is necessary to vary the opening between the jaws or when it is necessary to exit an uncrushable block of material, acting as a safety. The movement of the "fixed" jaw, in the two above mentioned cases, one can obtain by hinging in the upper part the jaw itself and fixing it on the underside with one or more oleo-hydraulic cylinders, analogous to those provided in the first realization described above, with the relative oleo-hydraulic circuit equipped with valves of maximum pressure. The said cylinders are connected to the "fixed" jaw, as well to the body of the machine, by means of rotary couplings. With this realization the part of the machine in continuos movement, with numerous cycles to the second, comprising power-operated eccentric shaft, mobile jaw and the well known connecting rod, is absolutely conventional, with all the advantages of a known solution of the technique and experimented in time, while the innovative part, regarding the correction and the safety is located on the "fixed" jaw, and carries out only occasional movements when the safety intervenes against uncrushable material blocks or uses the correction of the distance between the jaws.

A fourth realization of the invention, analogous to the preceding solution, provides the correction function of the distance of the jaws and the safety function against uncrushable material blocks, having the possibility of moving the "fixed jaw", which is hinged in its upper part by means of one or more oleo-hydraulic cylinders that do not however, act directly on the jaw itself, but through a system of division of the effort constituted of one or more coplanar articulated wedges, with median surface almost parallel to the median surface of the jaw itself and slideable on the surfaces lying in the concurrent plane, being a solid surface with the body of the machine and another solid surface with the fixed jaw and placing the cylinders in a plane almost parallel to the median surface of the jaw, in such a way that a motion of the articulated wedge parallel to the median plane of the jaw, for the actioning of the cylinders, is transformed in a perpendicular movement of the extremity of the fixed jaw, due to the said articulated wedge and of the cited sliding surfaces lying on the concurrent planes. The said wedge is articulated because it

must compensate the rotation of the solid sliding surface with the mobile jaw that in its movement rotates around the upper hanging point. The articulation of the said wedge is obtained by means of a rotary coupling between the two parts that interface on the sliding surfaces of the fixed jaw and of the body being-able to either coincide or not with the rotary coupling between the articulated wedge and the correction and safety cylinder. The angle of the said articulated wedge is studied in order to considerably reduce the effort that the cylinder must bear, having the possibility of discharging the incoming force from the fixed jaw, through the tilted walls of the wedge, directly onto the body of the machine. Finally, realizing the wedge as being unilaterally bound, the jaw will be equipped with a tensioning system that always holds it pushed against the wedge, this tensioning system could be constituted of one of the well known systems as for example one or more tie rods with springs or from more oleo-hydraulic cylinders connected to oleo-pneumatic accumulators.

In all the forms described above, the rotary couplings of cylinders and of the connecting-rods may be of unilateral or bilateral type, according to known technical solutions, necessitating the first type of tensioning system in the opposite direction of binding to hold everything mounted, the said operative tensioning system may also function as a system of recovering mechanical clearance due to the wearing of materials, the said system being composed of one or more oleo-hydraulic cylinders connected to an oleo-pneumatic accumulator; necessitating a second of a system of recovering the coupling clearances.

The invention is now better clarified with reference to the attached drawings that illustrate the five preferential realizations of practical forms, corresponding to the descriptions made above, supplied only for illustrative purposes, however not limiting inasmuch as technical or constructive variations may always be introduced without diverging from the present innovation. In the said drawings:

Fig. 1 shows a section of the new crushing machine in its most simple constructive form

Fig. 2, shows a section of the new crushing machine in its realizable form with intermediate flag guide between the well known connecting rod and the correction and safety cylinders;

Fig. 3 shows a section of the new crushing machine in its realizable form that provides the correction and safety cylinders placed behind the fixed jaw ;

Fig. 4 shows a section of the new crushing machine in its realizable form that provides the correction and safety cylinders that act on the fixed jaw through two opposite connecting-rods with unilateral rotary couplings;

Fig. 5 shows a section of the new crushing machine in its realizable form that provides the correction and safety cylinders that act on an articulated wedge placed behind the fixed jaw;

Figs. 6 and 7 show possible schemes of hydraulic connections that allow the cylinders to carry out the safety function against uncrushable material blocks and the correction of the jaws, respectively for the case of cylinders with unilateral or bilateral rotary couplings.

With reference to the Figures, 1 indicates the body of the crushing machine, 2 the solid flywheel with the eccentric shaft 3, which is connected with bearings, which, for simplicity, are not represented in the Figures, both to the body 1 and mobile jaw 4. Furthermore 5 is the fixed jaw that in Figures 1 and 2 is solid with the body of the machine, while in Figures 3, 4 and 5 it is hinged to the said body by means of the pivot 6. Number 7 represents one of the correction and safety cylinders that from one side is connected in all the Figures to the body 1 by means of the rotary coupling 8 and from the other it is connected by means of the rotary coupling 9: to the mobile jaw 4 in Figure 1, to the connecting flag rod 10, hinged to the body 1 by means of the pivot 14, in Figure 2, to the fixed jaw 5 in Figure 3, to the shackle 11 in Figure 4, and to the articulated wedge 12 in Figure 5. The element 14 is the traditional and well known connecting rod with unilateral cylindrical couplings 17 and 18 which are found in the crushing machines with jaws; analogously 15 is the tie rod that with the spring 16 traditionally forms the tensioning system that maintains the said connecting rod 14 in position and recovers the clearance due to the wear of the said cylindrical couplings 17 and 18. The dividing device of the effort coming from the fixed jaw of Figure 4 is made up of two connecting-rods 19 and 20 with unilateral cylindrical couplings 21, 22 and 23, 24 respectively, held in position by the above mentioned shackle 11, having the said effort dividing device of a traditional tensioning system for the maintenance in position of the different components and the recovery of clearances, composed of tie rod 25 and spring 26. In Figure 5 the dividing device of the effort coming from the fixed jaw 5 is formed of two sliding surfaces 27 and 28 between them inclined and the articulated wedge 12, composed of two elements 35 and 36, in contact respectively with the sliding surfaces 27 and 28, these being solid surfaces respectively to the body 1 of the machine and to the fixed jaw 5. Since the coupling between the articulated wedge 12 and the sliding surfaces 27 and 28 realizes a unilateral bond, a traditional tensioning system and recovery of clearances, formed by tie rod 29 and spring 30 renders the said bilateral bond.

In the oleo-hydraulic scheme of Figure 6, applicable to cylinders equipped with rotary bilateral couplings, with 7 the correction and safety cylinders are indicated and in 31 the maximum pressure valve; 32 an oleo-pneumatic accumulator and 33 a unidirectional valve.

In the oleo-hydraulic scheme of Figure 7, applicable to cylinders equipped with unilateral rotary couplings, the tensioning cylinder appears which serves to maintain the mobile jaw 4 in position and the said cylinders 7, also carrying out the function of salvaging clearances.

The functioning of the machine is the same as that in the crushing machines with traditional jaws, as far as it regards the normal treatment of the material to be crushed. When instead there is the necessity of adjusting the size of the material in exit, acting on the distance between fixed and mobile jaw, or when an uncrushable body enters the crushing chamber, between the fixed and mobile jaw, the functioning of the machine is the following:

in the illustrated configuration in Figure 1 the cylinders 7 directly displace the mobile jaw 4 varying the distance of the fixed jaw 5, for the correction of the size of the material in exit, while the said cylinders 7 can allow the complete opening between the two jaws 4 and 5 when the calibration pressure of the maximum pressure valve 31 is exceeded; the said cylinders 7 furthermore, have the same function as the connecting rod 14 of the Figures 2, 3, 4 and 5 that analogously to the traditional crushing machines, as regards the kinematics of the movable jaw;

in the configuration of Figure 2 the machine operates as in the traditional crushing machines, except that the rotary coupling 18 of the connecting rod 14 is not connected as in Figure 1 to the body 1, namely to a fixed part of the machine, but is linked to the intermediate flag guide 10 that can rotate around pivot 34, thanks to cylinders 7 of correction and connected safety to the said intermediate flag guide 10 by means of the rotary couplings 9 and body 1 by means of the rotary couplings 8, the tie rod 15 and spring 16 being one of the traditional tensioning systems and the recovery of clearances of the unilateral rotary couplings 17 and 18 of the connecting rod 14;

in the configuration of Figure 3 the whole part to the right of the "fixed" jaw 5, looking at the Figure, is analogous to that of a traditional crushing machine, while the "fixed" jaw 5 has its upper part hinged to the body 1 by means of hinge 6 and it is guided in its underside by the safety and correction cylinder 5, that is connected to the body 1 by means of the rotary coupling 8 and to the said "fixed" jaw by means of the rotary coupling 9, in this way the "fixed" jaw 5 stops in the set position during the normal functioning of the machine, but being-able to be displaced from cylinder 5 to vary the size of the material to be crushed in exit or being-able to open itself with respect to the mobile jaw in case of the introduction, between the jaws of an uncrushable body, due to the overcoming of the maximum pressure in cylinders 7 and opening of the valve 31;

in the configuration of Figure 4 the way of working of the machine is the same as that in the preceding configuration, except that between the "fixed" jaw 5 and the body 1 a dividing system for the effort coming from the mentioned "fixed" jaw 5 so as to be able to use cylinders 7 of simpler correction and safety, the said dividing devise being constituted of the effort of a couple of opposite connecting-rods 19 and 20, agents respectively on the rotary coupling 22 with the "fixed" jaw 5 and on the rotary coupling 24 with the body 1 and both concurrent by means of the rotary couplings 21 and 23 on the shackle 11 connected to the cylinders 7, furthermore the said effort division device being similar to that commonly used in mills with double toggle for the actioning of the movable jaw, and finally having a tensioning device and the recovery of clearances known to the technique, constituted of tie rods 25 and springs 26;

in the configuration of Figure 4 the way of working of the machine is the same as that in the preceding configuration, except that between the "fixed" jaw 5 and the body 1 an effort dividing system is inserted for the effort coming from the said "fixed" jaw 5 to be able to use cylinders 7 of simpler correction and safety, the said effort dividing device being constituted of one or more articulated wedges 12 endowed with sliding surfaces on the tilted faces that can slide on the surfaces 27 and 28 respectively solid to the body 1 and to the "fixed" jaw 5, the said articulated wedges being formed of two parts 35 and 36 connected between themselves by means of the rotary coupling 37, the said articulated wedges being moved from the correction and safety cylinders 7 and finally having the said effort division system for a tensioning device and the recovery of clearances known to the technique, constituted of tie rods 29 and springs 30.

Claims

1. Crushing machine with jaws equipped with a correction device of the distance between the jaws for regulating the size of the material in exit and of a safety device against uncrushable material blocks characterized by the fact that the correction and safety device is constituted of oleo-hydraulic cylinders, interposed between one of the two jaws and the body, the said cylinders being connected to an oleo-hydraulic

circuit, for the safety function, for the correction function of the distance between the jaws and for the re-arming in case of entry in function of the safety device, endowed with one or more maximum pressure valves.

2. Crushing machine with jaws according to preceding claim characterized by the fact that the oleo-hydraulic cylinders of the correction and safety device are constrained by means of bilateral rotary couplings

3. Crushing machine with jaws according to claim 1 characterized by the fact that the oleo-hydraulic cylinders of the correction and safety device are endowed with unilateral rotary couplings with a tensioning system that also has the function of recovering the clearances.

4. Crushing machine with jaws according to preceding claim characterized by the fact that the tensioning system of the correction and safety cylinders with unilateral rotary couplings is constituted of one or more oleo-hydraulic cylinders connected to one or more accumulation oleo-pneumatic.

5. Crushing machine with jaws according to one of preceding claims, characterized by the fact that the correction and safety device, is placed between the body and the mobile jaw, the said device also carrying out the function of the well known connecting rod that defines the kinematics of the mobile jaw.

6. Crushing machine with jaws according to one of claims 1, 2, 3 or 4, characterized by the fact that the correction and safety device is placed between the body and an intermediate guide, the said intermediate guide being of the linear type with sliding surfaces or of a flag type hinged on the same body, and the said intermediate guide being connected to the mobile jaw by means of the well known connecting rod equipped with a tensioning system and of the recovery of clearances.

7. Crushing machine with jaws according to one of claims 1, 2,3 or 4, characterized by the fact that the oleo-hydraulic correction and safety cylinders are placed between the body and fixed jaw, the latter being hinged upwardly to the body and having the possibility of moving to check on the size of the material in exit and for safety against uncrushable material blocks thanks to the said oleo-hydraulic cylinders.

8. Crushing machine with jaws according to preceding claim, characterized by the fact that the correction and safety cylinders do not act directly on the fixed jaw but indirectly by means of a mechanism of a double connecting rod connected to the said cylinders through unilateral or bilateral rotary couplings or even not coaxial, placing the connecting-rods and the said cylinders in three concurrent planes, and the falling plane of the said cylinders being more or less parallel to the median plane of the fixed jaw.

9. Crushing machine with jaws according to claim 7, characterized in that the correction and safety cylinders do not act directly on the fixed jaw, but indirectly through an articulated wedge-shaped mechanism which, moved by the above mentioned cylinders, lying more or less parallel to the median plane of the fixed jaw, it is in contact from one side with the body and from the other with said fixed jaw by means of two sliding surfaces lying in concurrent planes in a line parallel to the median plane of the said fixed jaws, the said articulated wedge being formed of two parts with sliding surfaces, these said parts being connected between them by means of a unilateral or bilateral rotary coupling that allows the said sliding surfaces to assume the same angle of the respective interfacing surfaces of the body and of the fixed jaw, varying the said angle for the effect of the turning of the fixed jaw, in case of the entering into function of the correction system of the size of the material in exit or of the safety system against uncrushable material blocks.

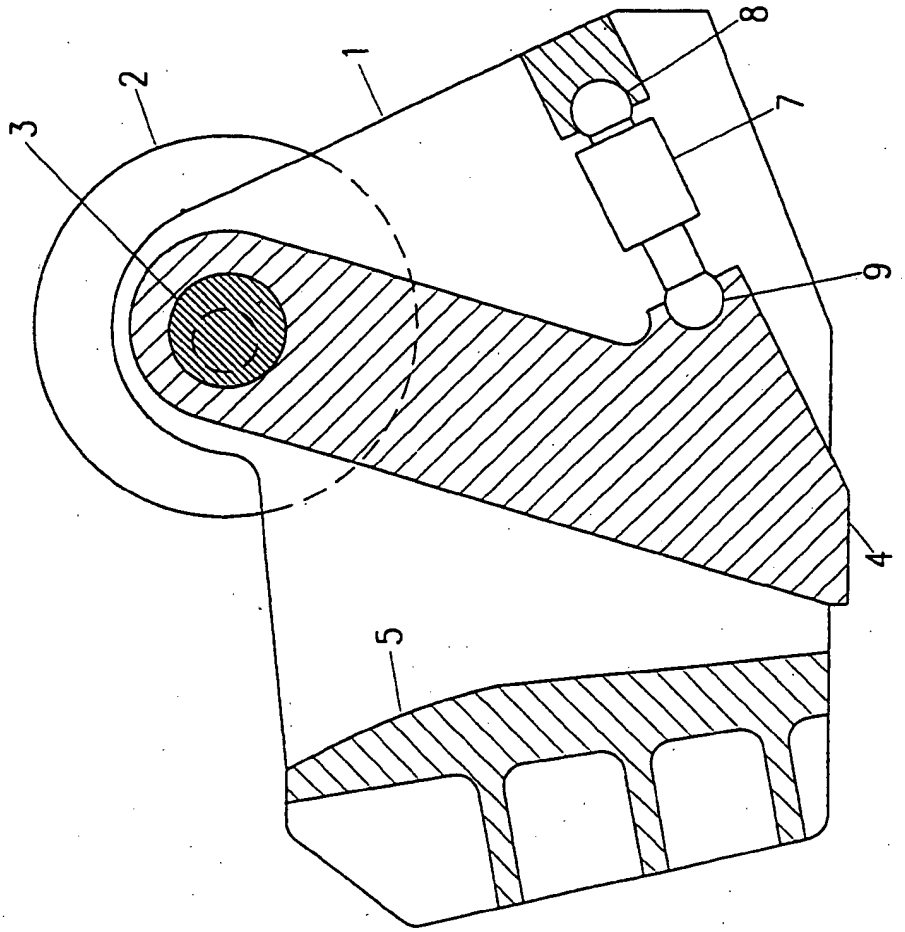


FIG. 1

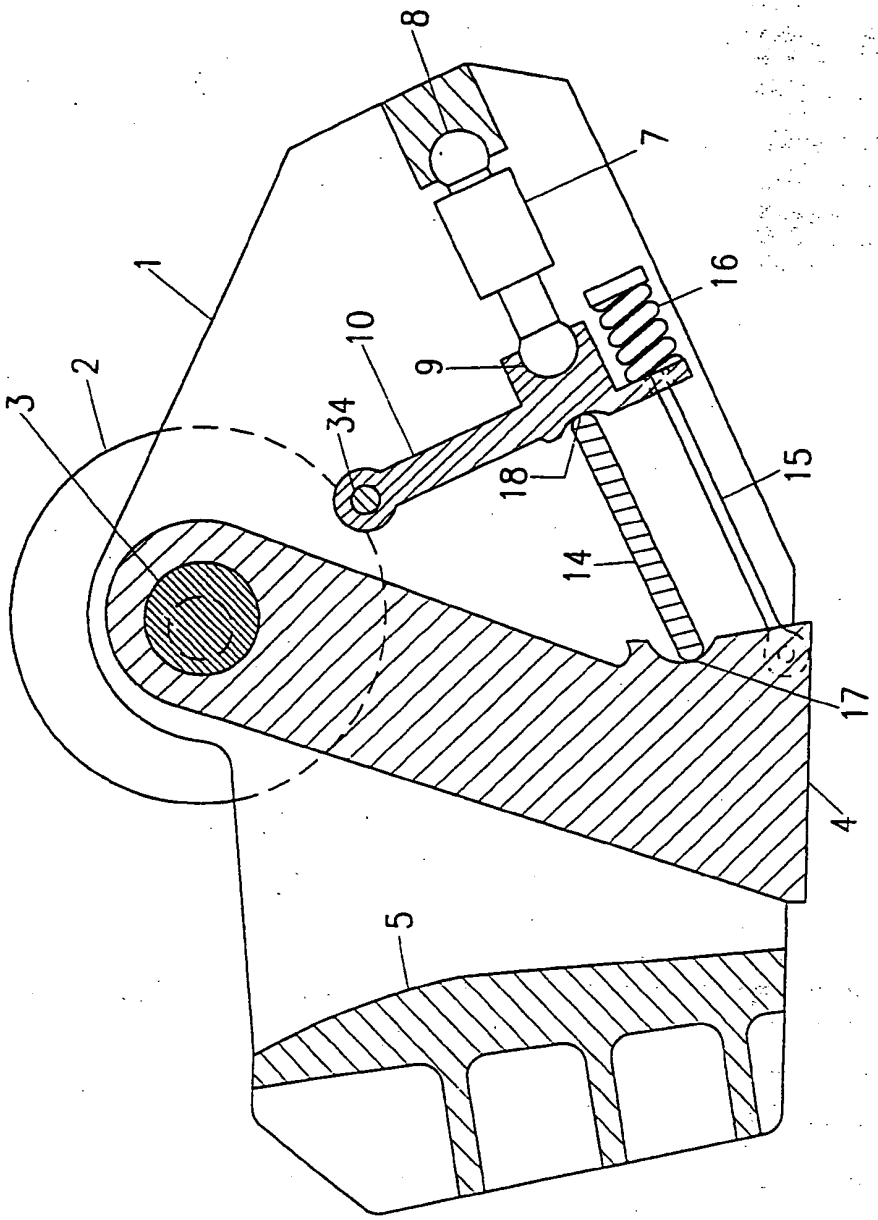


FIG. 2

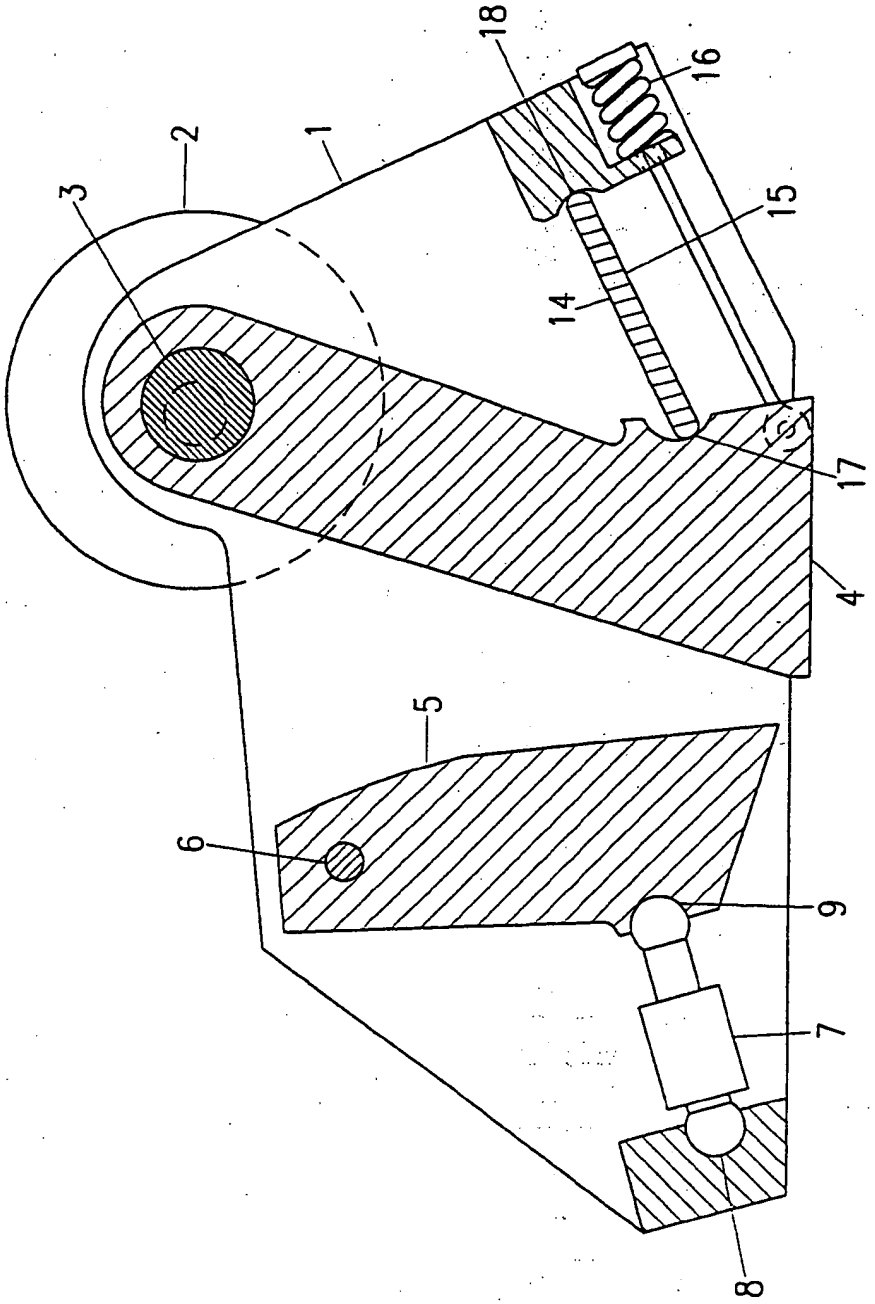


FIG. 3

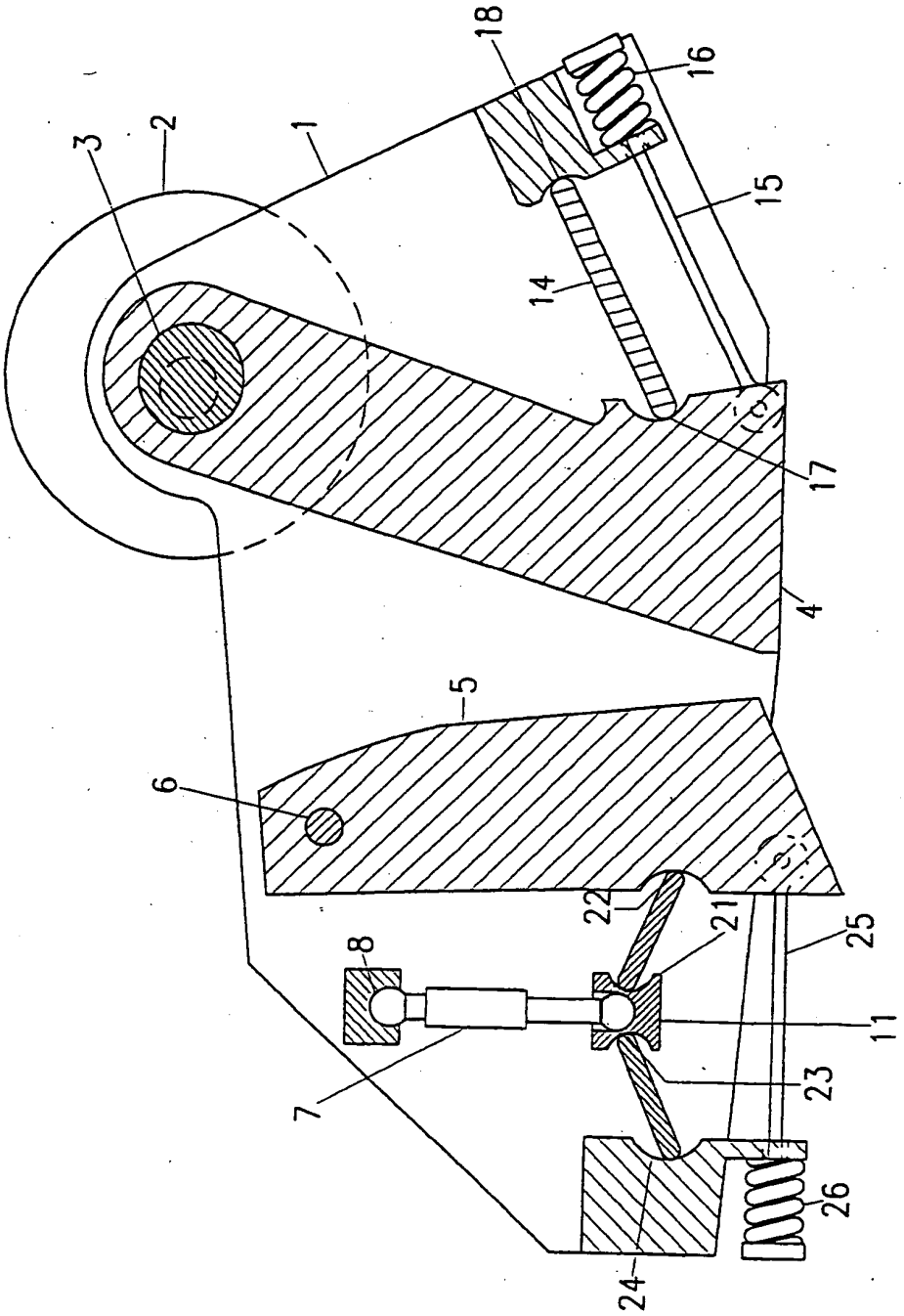


FIG. 4

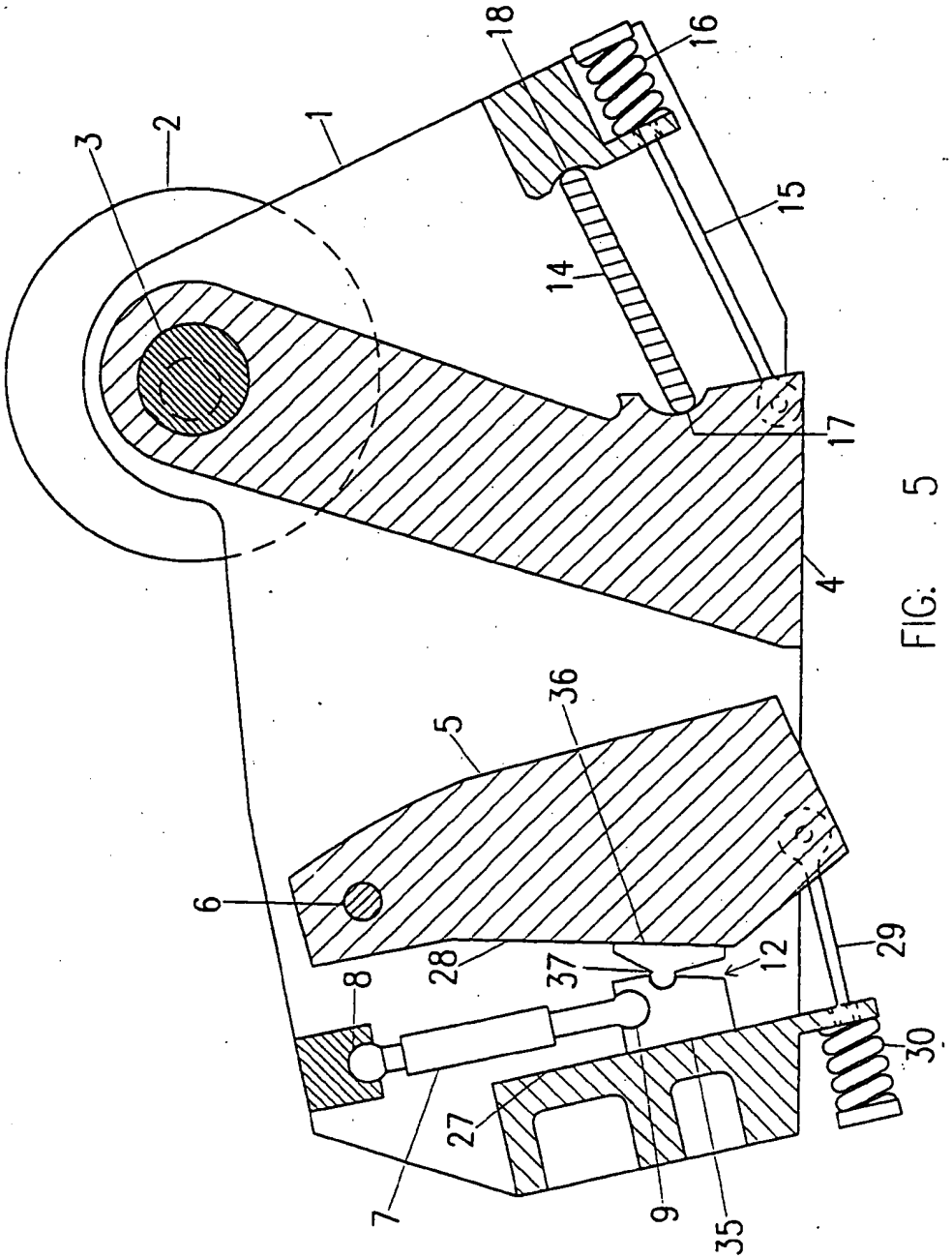


FIG. 5

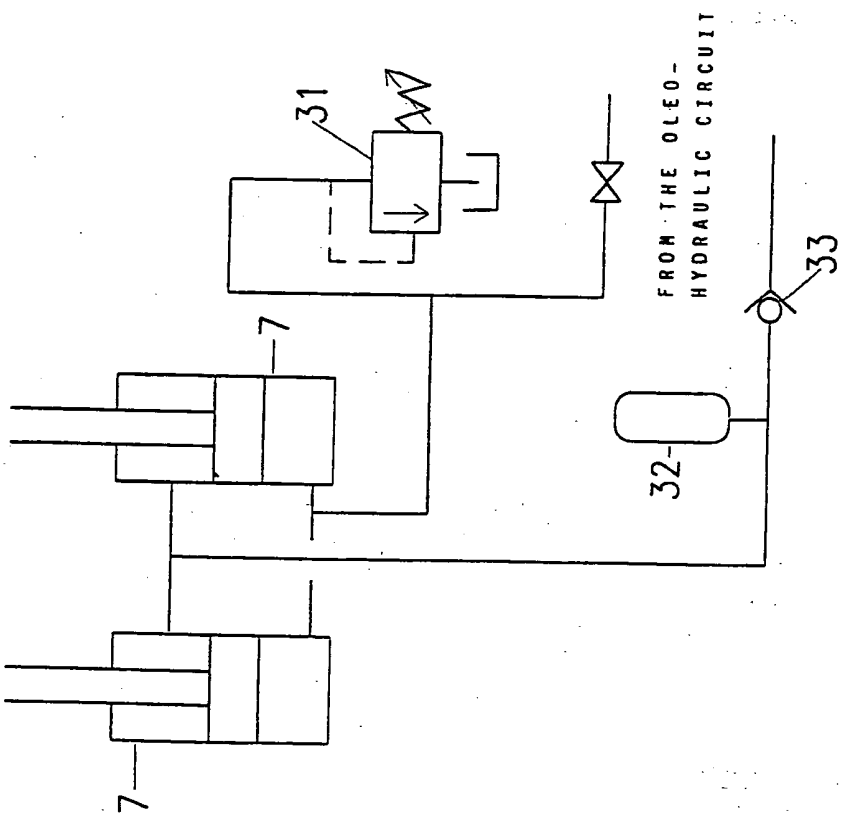


FIG. 6

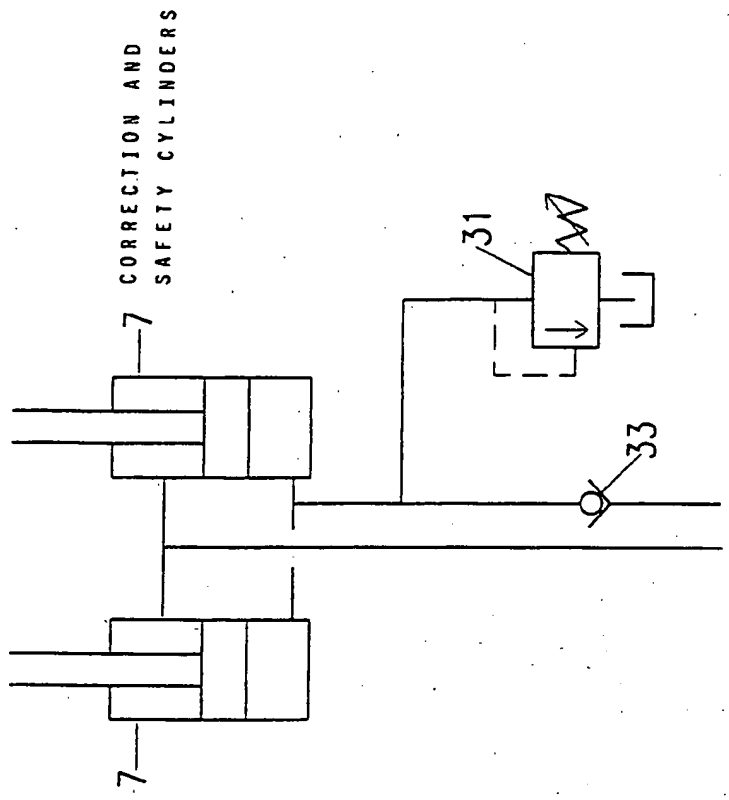
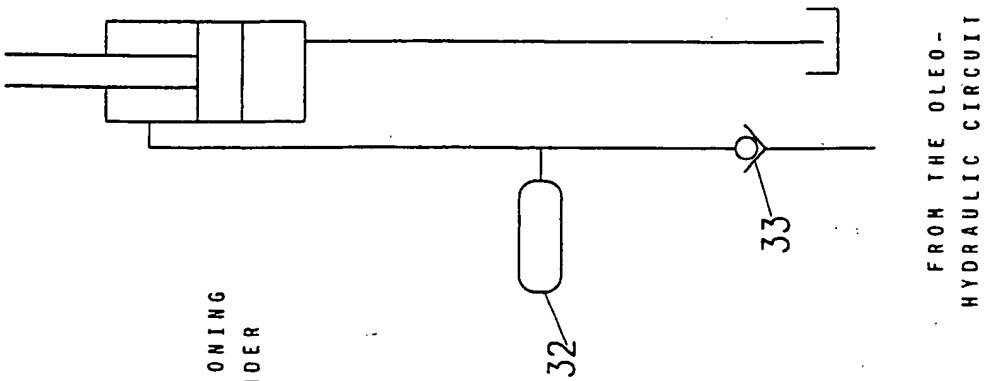

CORRECTION AND
SAFETY CYLINDERS
7
31
33
7

FIG. 7


TENSIONING
CYLINDER
32
33
FROM THE OLEO-
HYDRAULIC CIRCUIT

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Application Number
EP 94 11 4080

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X A	US-A-3 099 406 (H.P. KAUTZ) * column 1, line 44 - line 64; figures 2,4,5 * * column 4, line 37 - column 5, line 58 *	1,2,5 3,4,7	B02C1/02
X Y A	EP-A-0 433 500 (J. ALTMAYER) * the whole document *	1,3,5 7 2,4	
X Y A	GB-A-648 443 (K. GAULDIE) * page 6, line 30 - line 58; figures 1,2 *	1,3,5 7 2,4,6,9	
Y A	DE-B-11 64 211 (MASCHINENFABRIK KÖPPERN & CO. K.G.) * column 4, line 1 - line 29; figure 2 *	1-8 2,4,9	
Y	US-A-4 749 132 (T. HAGIWARA) * abstract; figure 1 *	1-8	
Y	DE-B-12 37 414 (KLÖCKNER-HUMBOLDT-DEUTZ AG.) * the whole document *	1-8	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B02C
Y	US-A-2 982 481 (R.G. OSBORNE) * column 9, line 4 - column 10, line 30; figure 7 *	1-8	
Y	PATENT ABSTRACTS OF JAPAN vol. 1, no. 137 (M-046) 11 November 1977 & JP-A-52 078 157 (KOBE SEIKOSHO K.K.) 1 July 1977 * abstract *	1-8	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 December 1994	VERDONCK, J

CATEGORY OF CITED DOCUMENTS

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